Topic : **Study of dielectric and electrical behavior of some Biocompatible polymer blends and composites**

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Rationale and significance of study:

In recent times the studies on polymer based composites are finding an important place in different research laboratories due to their low cost, light weight, design flexibility, corrosion resistance and ease of mass production[1]. The polymer-based composites are finding increasing use in various advanced technological applications such as energy storage, antistatic packaging, electro-optical devices, and electromagnetic interference (EMI) shielding. Because of the wide use of commercial, military, and scientific electronic devices and communication instrument ,EMI shielding of radio frequency and microwave radiation continues to be a serious concern for modern society. Compared to conventional metal based shielding materials, electrically conductive polymer blends and composites have gained popularity . Conductive polymer composites can be obtained by either mixing an insulating polymer with conductive fillers or conducting polymers .The Conducting polymers have emerged as an important class of electronic materials possessing electrical conductivity comparable to metals and semiconductors. The conducting polymers such as Polyaniline and Polypyrrole are specially promising for commercial application because of their good environmental stability , facile synthesis and higher conductivity than many other conducting polymers.

In present study the blending of various types of biocompatible insulating polymers with conducting polymers and also using suitable fillers for the preparation of polymer composite films is being planned. The study of structural , thermal, dielectric , electrical and optical behaviour of these blend/composite films is planned for their possible applications in the fields of electromagnetic shielding, electro optical- devices , designing of super capacitors and microstrip transmission line etc. [1,2,3]

Survey / field work done in this area:

Considerable work has been done at low and microwave frequencies on polymeric composite materials. Subba Reddy et al[2] studied the dielectric spectroscopy of PVP + PVA poly blend films in the frequency range 1-100K Hz and temperature range 298-423 K. Tanvar et al have investigated dielectric properties of pure and doped PMMA films at 8.92 G Hz microwave frequency and at room temperature.[1,3] Bahaa Hussein et al studied the effect of alumina additive on dc and ac electrical properties of PMMA composites[4]. Avanish Singh et al studied the conduction mechanism in PANI-Flyash composite material for shielding against EMR in microwave region [5].

3. Statements of Aims and Objectives:

1.Preparation and Structural Characterization of polymer blends and composite materials . Thermal stability of the material will be studied. The focus will be on environmentally suitable polymers and conducting polymers.

2. To study the Dielectric and Electrical properties of these materials at low and high frequency (Microwave) ranges. To investigate the effect of different fillers on these properties.

3. To study the optical properties of these polymer blends/composites.

4. To identify the possible applications of these materials for electromagnetic shielding , capacitors , micro strip transmission line etc.

5. To examine the applications of these blended materials in the field of drug delivery system and biomedical implants.

4. Methodologies and Technologies:

It is proposed to blend polymers like PVA (Polyvinyl Alcohol), PVP (Polyvinylpyrrolidone) and PMMA (Polymethamethylacrylate) with Polypyrrole (PPy) which is a conducting polymer. Blended films/pallets of these polymers with different proportion of fillers like TiO_2 , MWCNT and Graphene Oxide will be prepared. The structural characterization is proposed to be done using XRD, FT-IR and SEM analysis. The thermal stability will be investigated using DSC/TGA studies. Further, it is proposed to measure the surface energies

of these films by measuring the contact angle with water with static contact angle goniometer, to study the hydrophilicity of the films. The optical properties of these films would be studied by using UV-VIS Spectrometer.

The dielectric and electrical properties of these films at low frequency range (20 Hz to 2MHz) will be measured using Agilent LCR meter. The dielectric behaviour of these films in high frequency range of 300MHz to 30 GHz will be studied using a vector network analyser. The electromagnetic shielding effectiveness is to be studied.

5. Kinds of conclusions expected:

1. Since insulating polymers like PVA, PVP and PMMA are used to make blend films it is expected that the dielectric constants of these films at low frequency will be high.

2. The films are expected to show better transparency on account of PMMA being used as one of the component in the blend films.

3. Use of conducting polymer as an additive in the insulating polymer matrices is expected to enhance the conductivity thereby showing a better EMI shielding effectiveness.

4. Since a filler with high dielectric constant, high refractive index is proposed to be added to the blend films it is expected that these films will also show enhanced dielectric constant and opacity.

6. Plan of research:

First year would be dedicated for Literature review and collecting references.

In second and third year the experimental work will be carried out and various measurements would be done.

The fourth year would be utilized for analysing the data.

In the fifth year, writing and submission of the thesis and paper publishing would be done.

7. Bibliography:

[1] A Tanwar, K K Gupta, P J Singh and Y K Vijay, Dielectric parmeters and a.c. conductivity of pure and doped polymethylmethacrylate films at microwave frequenciess,Bull. Mater. Sci., Vol 29, No. 4, August 2006(397-401).

[2] Subba Reddy, Xia Han, Quan-Yao Zhu, Li-qiang Mai and Wen Chen, Dielectric spectroscopy of PVP + PVA poly blend film, Microelectronic engineering,83,2006 (281-285).

[3] A Tanwar, K K Gupta, P J Singh and Y K Vijay, Dielectric measurements on PWB materials at microwave frequencies,Bull. Mater. Sci., Vol 29, No. 2, April 2006 (181-185).

[4] Baha Hussein, The Dc and AC electrical properties of PMMA-Al2O3 composites,European Journal of Scientific Research Vol. 52,No.2,2011(236 –242).

[5] Avanish Pratap Singh, Anoop Kumar S., Amita Chandra and S.K. Dhawan, Conduction mechanism in polyaniline-Flyash composite material for shielding against electromagnetic radiation in X-band and Ku- band,AIP Advances, 022147,2011(1 –11)

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